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09 MAR 2004

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Patent Office

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PCT REQUEST

Original (for **SUBMISSION**)

0	**For receiving Office use only**	
0-1	International Application No.	PCT/IL2004/000001
0-2	International Filing Date	01 JAN 2004 (01.01.2004)
0-3	Name of receiving Office and "PCT International Application"	ISRAEL PATENT OFFICE PCT International Application
0-4	**Form - PCT/RO/101 PCT Request**	
0-4-1	Prepared Using	PCT-SAFE [EASY mode] Version 3.50 (Build 0002.150)
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	Israel Patent Office (RO/IL)
0-7	**Applicant's or agent's file reference**	16990-WO-03
I	**Title of Invention**	DEVICE AND METHOD FOR COOLING CATTLE IN SHEDS
II	**Applicant**	
II-1	This person is:	applicant and inventor
II-2	Applicant for	all designated States
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II-5	Address:	7 Avuka Street 69086 Tel Aviv Israel
II-6	State of nationality	IL
II-7	State of residence	IL
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IV-2	**Additional agent(s)**	additional agent(s) with same address as first named agent	
IV-2-1	Name(s)	LUZZATTO,Esther; LUZZATTO,Edgar; HACKMEY,Michal; FUERST,Zadok; CHECHIK,Haim; MANZUROLA,Emanuel; ZRIHAN-LICHT,Sheila; JACOBSON,Zvi-Michael; GUTTMAN,Thomas; ALPERT,Bruce; CROITORO,Boaz; WEISS,Shmuel; HACKMEY,Miriam; SHALEV,Ronit; PALMERY,Amir; MANDLER,Oren; LAVON,Avi	
V	**DESIGNATIONS**		
V-1	**The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.**		
VI-1	**Priority Claim**	NONE	
VII-1	**International Searching Authority Chosen**	United States Patent and Trademark Office (USPTO) (ISA/US)	
VIII	**Declarations**	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	-	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	-	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	
IX	**Check list**	number of sheets	electronic file(s) attached
IX-1	Request (including declaration sheets)	3	-
IX-2	Description	16	-
IX-3	Claims	5	-
IX-4	Abstract	1	✓
IX-5	Drawings	11	-
IX-7	TOTAL	36	

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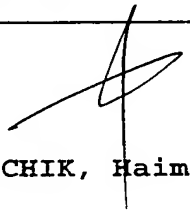
	Accompanying Items	paper document(s) attached	electronic file(s) attached
IX-8	Fee calculation sheet	✓	-
IX-9	Original separate power of attorney	✓	-
IX-17	PCT-SAFE physical media	-	✓
IX-19	**Figure of the drawings which should accompany the abstract**		
IX-20	**Language of filing of the international application**	English	
X-1	**Signature of applicant, agent or common representative**		
X-1-1	Name:	CHECHIK, Haim	
X-1-2	Name of signatory		
X-1-3	Capacity		

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	01 JAN 2004 (01.01.2004)
10-2	**Drawings:**	
10-2-1	Received	✓
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	ISA/US
10-6	**Transmittal of search copy delayed until search fee is paid**	✓

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	

PCT (ANNEX - FEE CALCULATION SHEET)

Original (for **SUBMISSION**)

(This sheet is not part of and does not count as a sheet of the international application)

0	**For receiving Office use only**	
0-1	International Application No.	PCT/IL2004/000001
0-2	Date stamp of the receiving Office	01 JAN 2004 (01.01.2004)

0-4	**Form PCT/RO/101 (Annex)** **PCT Fee Calculation Sheet**				
0-4-1	Prepared Using		PCT-SAFE [EASY mode] Version 3.50 (Build 0002.150)		
0-9	**Applicant's or agent's file reference**		16990-WO-03		
2	**Applicant**		POLAK, Arieh Jehuda		
12	**Calculation of prescribed fees**		fee amount/muliplier	Total amounts (ILS)	Total amounts (USD)
12-1	Transmittal fee	T	⇨	476	
12-2-1	Search fee	S	⇨		1000
12-2-2	International search to be carried out by		US		
12-3	International filing fee (first 30 sheets)	i1	1035 USD		
12-4	Remaining sheets		6		
12-5	Additional amount	(X)	11 USD		
12-6	Total additional amount	i2	66 USD		
12-7	i1 + i2 =	i	1101 USD		
12-12	EASY Filing reduction	R	USD-74		
12-13	Total International filing fee (i-R)	I	⇨		1027
12-14	Fee for priority document Number of priority documents requested		0		
12-15	Fee per document	(X)	0 ILS		
12-16	Total priority document fee:	P	⇨		
12-17	**TOTAL FEES PAYABLE (T+S+I+P)**		⇨	476	2027
12-19	**Mode of payment**		cash		

DEVICE AND METHOD FOR COOLING CATTLE IN SHEDS

Field of the Invention

The present invention relates to an apparatus and method for cooling cattle, by means of coordinated groups of spray devices which direct spray streams to rows of said cattle in a controlled manner that accounts for environment conditions. Particularly, though not exclusively, said cattle are cows and the cooling method and apparatus are applied when the cows are housed in a shed and the relevant environment conditions are defined by the prevalent wind streams.

Background of the Invention

One of the requirements for high milk production in summer is relieving heat stress. Several studies have determined that milk production can be increased by installing cooling systems. ("Interactions Between Body Condition at Calving and Cooling of Dairy Cows during Lactation in Summer," Flamenbaum et al , Journal of Dairy Science, Vol. 78, No. 10, 1995 and "Dry Period Heat Stress Relief Effects on Prepartum Progesterone, Calf Birth Weight, and Milk Production," Wolfenson et al, Journal of Dairy Science, Vol. 71, No. 3, 1988). A side benefit to the installation of such cooling systems is that the reproductive performance of cows can be improved with cooling.

A prior art cooling system generally consists of an air distribution duct for directing a turbulent air stream onto the cows and a separate water line that terminates with a nozzle which produces a spray. Nozzles are commonly used, in contrast with discharge directly from a hose, to conserve water. Sprinklers that are positioned in the feeding area of a dairy farm generally provide supplemental cooling, reducing the fan power needed and enabling a marginally hot cow to be much more comfortable.

Since cows sweat only one-tenth as much as humans, a spray-fan cooling system conducts away surface heat and increases the vaporization of moisture from the skin. This body cooling effect enhances comfort and increases milk production.

Although prior art systems provide adequate cooling, they suffer from some drawbacks. Firstly, an inordinate amount of water is wasted. The cooling water is not necessarily directed at the cows, but rather it is discharged throughout a wide region, e.g. within the feeding area, so that an optimal number of heated cows will be cooled by the spray of water. In order to spray water throughout a wide region, a pump and steel pipes are needed so that water may be provided to a spray device at a pressure of approximately 40 atmospheres. Secondly, cows may not seek a spray-cooled comfort zone, and therefore the spray may not be effectively utilized. Water that does not impinge upon the hair coat of a cow falls to the ground. Thirdly, the water that falls to the ground generally collects as puddles, serving as a source of diseases to the cows, such as mastitis, especially in combination with cow droppings, despite the constant operation of a fan that additionally functions as a means to dry the ground. Also, water is sprayed at times on the face of the cows, thereby causing them much aggravation.

Copending patent application WO 03/066168 A1 discloses a spray device for comprising a fan for producing a mist stream and propelling to a predetermined location, viz. to a head of cattle, typically a cow. It is stated therein that when cows are interspersed throughout a large area, namely in the feeding area, corral and waiting pen, a plurality of spraying devices can be employed, each of which directs a controllable mist spray to a different location, viz. to a different head of cattle. While the device of WO 03/066168 A1 is highly effective, it only cools one cow or other head of

cattle at a time and must be operated and controlled manually by a person. It is therefore unsatisfactory for cooling rows of cattle in a shed, particularly for extended periods of time, as is often the case, and with varying atmospheric conditions, because it would require a functionally and economically unacceptable use of manpower.

Other prior art, listed in said PCT application, should be considered as cited herein as well, by reference.

It is an object of the present invention to provide a method and apparatus for cooling cattle arranged in rows, particularly cows housed in a shed.

It is a further object of the present invention to provide such a method and apparatus that is automatically controlled.

It is a still further object of the present invention to provide such a method and apparatus that automatically take into account the influence of the wind.

It is a still further object of the present invention to provide such a method and apparatus that minimize the consumption of water.

It is a still further object of the present invention to provide such a method and apparatus that are efficient no matter what is the configuration of the cattle shed.

It is a still further object of the present invention to provide such a method and apparatus that are efficient when the cattle are arranged in a plurality of rows at an angle to each other.

Other objects and advantages of the invention will become apparent as the description proceeds.

Summary of the Invention

The method of the present invention, for cooling cattle, particularly cows, distributed in an orderly configuration, particularly in corrals and more particularly in a shed, comprises the following steps:

a) providing a plurality of spray generators;
b) distributing said spray generators in a configuration corresponding to the configuration in which the cattle are distributed, particularly corresponding too the cattle rows in a shed;
c) concurrently actuating said spray generators to generate water sprays, each of them directed substantially to at least one cow body;
d) sensing the direction and optionally the speed and/or other relevant parameters, if any, of the wind; and
e) concurrently changing the direction of the water sprays according to the direction and optionally the speed and/or other relevant parameters, if any, of the wind, in such a way that each spray will still be directed substantially to at least one cow body.

While the cattle are typically cows, they may be other kinds of cattle; while the orderly configuration in which they are distributed is typically the configuration of rows in a shed, it may be a different configuration as long as the spray generators are distributed in a corresponding configuration, so that the water sprays may reach the cattle; and the cattle may not be in a shed. All such variants are comprised in the invention.

The apparatus of the present invention, for cooling cattle, typically cows, distributed in an orderly configuration, particularly in rows and more particularly in a shed, comprises the following components:

I – a plurality of water spray generators, arranged in a configuration corresponding to the said orderly configuration of the cattle;

II – actuating means for concurrently actuating and concurrently stopping all of said water spray generators;

III – wind sensor means for sensing the direction and optionally the speed and/or other relevant parameters, if any, of the wind;

IV – kinematic connecting means for concurrently controlling the direction of the water sprays generated by said water spray generators; and

V – means for actuating said kinematic means according to the direction and optionally the speed and/or other relevant parameters, if any, of the wind sensed by said sensing means.

Preferably, if said water spray generators, hereinafter briefly called "sprayers", are considered as arranged in a succession, particularly in a row or rows, said kinematic means connect each sprayer to the next, and concurrently change or adjust, if and when needed, the direction of the water sprays generated by them. The direction of the water sprays is changed or adjusted by angularly displacing the sprayers about a substantially vertical axis.

The sprayers preferably comprise each a fan having blades defining a blade diameter, and a guard grille, and comprises a nozzle unit for feeding water from a feed conduit, which is being centrally mounted on the downstream side of the grille and the blades. Said sprayers may be as described in the aforesaid WO 03/066168 A1, but may also be different. In the embodiment described in WO 03/066168 A1, each nozzle unit is essentially concentric with the fan blades, comprises one or more nozzles essentially symmetrically positioned with respect to the center of the fan blades, and has preferably a low profile, viz. creates the smallest possible

disturbance to the stream of air generated by the fan. The pressure of the liquid introduced to the nozzle unit is a relatively low pressure, ranges from 4 to 6 atmospheres.

In order that the direction of the water sprays generated by the sprayers may be controlled, each of said sprayers must be pivotally displaceable about a vertical axis. Changes in the wind direction and velocity also affect the water spray range, which decreases/increases, all other things being equal, as the component of the wind along the desired direction of the water spray decrease/increase. In a limit condition, if said component is reversed, viz. if the wind blows in the opposite of said desired direction, the water spray range decreases/increases as said component increases/decrease, and said range may become zero or even be reversed. Therefore the direction and speed of the wind and/or other relevant parameters, if any, sensed by the wind sensor are preferably transmitted to a computer which outputs the calculated rotation of the sprayers about a vertical axis, viz. the horizontal rotation, required to maintain the desired direction and range of the water sprays. Said other relevant parameters may include the humidity of the wind and its temperature. The computer issues a command to change the direction of the sprayers only if the wind sensor maintains its new position for at least several minutes, in order to eliminate response to temporary changes in the wind direction.

Preferably, each sprayer is mounted on a horizontal axis which is the bottom side of a quadrilateral, preferably rectangular, support. Said support, specifically its top side if the support is rectangular, is solid with a short, vertical shaft, which is retained and rotatably mounted in a sleeve attached to a static element, e.g. a partition, of the cattle shed. Said vertical shaft carries a first or high gear wheel and a second or low gear

wheel. Other structural arrangements are of course possible, as long as the sprayer can be rotated about a vertical axis with respect to a static structural element.

A control station is provided for controlling the direction of the sprayers. The kinematic connecting means for concurrently controlling the direction of the sprayers may be of any kind that appears convenient to skilled persons, but preferably comprises, for each sprayer, a two-way flexible member, viz. a flexible member, e.g. a metal or plastic or textile cable, that is continuous as it comprises two legs connected at both their ends. A two-way flexible member passes around the vertical shaft of each sprayer. The sprayer closest to said control station will be called the first sprayer, the successive one will be called the second sprayer, and so on till the last sprayer. The flexible member that passes around the vertical shaft of the first sprayer, also passes around a support located at said control station, and will be called the first flexible member. Each flexible member other than the first pass around the vertical shafts of two adjacent sprayers, viz. one sprayer and the preceding sprayer, wherein "preceding" means the sprayer that is nearest to said one sprayer and is closer to the control station. Means are provided for displacing said first flexible member along itself, e.g. means for paying out one of its legs and drawing in the other leg, from said control station, wherein said means may be actuated merely by a manual action. Transmission means are provided for translating the displacements of said legs into rotation of said first sprayer about a vertical axis. Said transmission means may comprise, in an embodiment of the invention, the aforementioned first/second gear wheel of the first sprayer and a meshing first gearing, viz. row of gear teeth, carried by said first flexible member. The second/first gear wheel of the first sprayer meshes with a second gearing carried by a second, two-way flexible member, and when said wheel rotates, it displaces said second flexible

member along itself. Said second flexible member engages a first/second gear wheel keyed to the vertical shaft of the second sprayer, and, when it is displaced along itself, causes said first/second gear wheel to rotate. The rotation is thus transmitted from the first sprayer to the second, and is transmitted in the same way from the second sprayer to the thirst, and so on, till the last sprayer. In this way the desired rotation is carried along the row of sprayers from the one closest to the control point to the farthest.

The range of the water sprays also depends on the slant of the sprayers, viz. the angle that the axis of each sprayer makes with a horizontal plane. Therefore it may be desirable, according to an embodiment of the invention, to vary or adjust said slant. This would require rotating the sprayer about a horizontal axis, which can be done manually. However, said rotation, if desired, as well as other actions that may be desirable for the operation of the sprayers, such other actions being described for instance in WO 03/066168 A1, may be generated and controlled by control means, typically electromagnetic means, known per se, that may be included in the fans or in the supports of the sprayers or otherwise mounted. The concurrent actuations of such means is within the ability of skilled persons and need not be described.

For example, one of such control means may cause and control the intermittent cooling of cows. Optimal cooling of cows will take place when the water sprays are produced intermittently. By closing the water inlet to the nozzle units of the sprayers, cows will not be over-wet and water will be conserved. After the cows are wetted and the water inlets are closed, the air streams may continue to flow, so as to continue water evaporation and cooling from the cows.

A feature of this invention is that, since the angular adjustment is

transmitted from one sprayer to the next, it permits to adapt to any orderly configuration of the cattle, and particularly to any layout of the shed. For instance, if the cows are aligned successively along two lines forming an angle to one another, the sprayers may be similarly aligned, one of them being located at the junction of the two lines. If it is not necessary to place a sprayer at said junction: only a vertical shaft having two gear wheels keyed thereto need to be placed at said junction and it need not be the shaft of a sprayer. Several such shafts permit to deal with more complicated configurations of cattle and/or shed layouts, and with consequent irregular alignments of the cow positions and of the sprayers. Likewise, if the cows and therefore the sprayers are aligned successively along two lines situated on different levels, the angular adjustment is transmitted from one sprayer to the next, where said level changes, by means of slanted flexible members; and the same means may be used to transmit the angular adjustment from one sprayer to the next in other configurations of the sprayers on a plurality of levels.

Brief Description of the Drawings

In the drawings:

- Fig. 1 is a front view of a spray device rotatable about a vertical axis, according to a first embodiment of the present invention;
- Fig. 2 is a perspective view of the spray device of Fig. 1 in another angular position.;
- Fig. 3 illustrated the connection between the control station and the first sprayer according to an embodiment of the present invention;
- Fig. 4 is a schematic plan view illustrating the application of the invention to two rows of cows in a shed;
- Fig. 5A is a schematic plan view illustrating the application of the invention to two row of cows at an angle to one another in a shed;

- Fig. 5B is a schematic plan view illustrating the application of the invention to in a shed where a closed is formed by the sprayers' path;
- Fig. 6 schematically illustrates an embodiment of the invention when the sprayers are at two different vertical levels;
- Fig. 7 is a detail of Fig. 3 at an enlarged scale;
- Fig. 8 is a schematic illustration of a wind sensor; and
- Figs. 9 and 10 show an example of the influence of a transverse wind on the angular adjustment of the sprayers..

Detailed Description of Preferred Embodiments

In Figs. 1 and 2 numeral 10 indicates a static element of the shed, which can be a partition or a wall but could also be an open structure through which the water sprays can pass if the direction of the sprayers is reversed.

The sprayer is generally indicated at 11, mounted at a convenient height on static element 10, in the way hereinafter described, and slanted downwards as required in order to obtain the desired range of the water spray, taking into account the said height. Sprayer 11 comprises a fan 12 and a water inlet through a water feed pipe 13, which, as seen in Fig. 2, may be fed from a water main 35. The sprayer is mounted on, and is angularly displaceable about, horizontal pivot means, which may consist of two pivots 14 or of a horizontal rod. The pivots or rod define the bottom side of a rectangular support 16, which also includes an upper horizontal side 17 and two vertical lateral sides 18. Said rectangular support, of course, is only an example and differently shaped supports may be used. Upper side 17, and therefore support 16, is solid with a shaft 21. Said shaft 21 is rotatably mounted in sleeve 19 which is attached to an arm 15, supported by to structure element 10, which keeps sprayer 11 at such a distance from component 10 that said sprayer may be rotated about a

vertical axis as desired, even by 180 degrees. Arm 15 is shown as broken off in Fig. 1, but in Fig. 2 a way is shown of supporting it from structure element 10. Arm 15 is rigidly connected to a support 36, which in turn is connected to a sleeve or like hollow member indicated at 29, attached to structure element 10, through which wires or other connections can pass and be guided. However, this is only an example of a way in which arm 15 can be supported by to structure element 10 and many other supporting ways may be devised by skilled persons and implemented in carrying the invention into practice.

As has been said, shaft 21 is rotatably mounted in sleeve 19. Any suitable means, not visible in the drawing, is provided for preventing said shaft from sliding along and/or out of said sleeve, e.g. a preferably annular projection can be formed around shaft 21 and engage a preferably annular seat in the inner surface of sleeve 19, or such a projection can be formed around the inner surface of said sleeve and engage a corresponding seat formed on the surface of said shaft. Shaft 21 carries an upper gear wheel 23 and a bottom gear wheel 24. A two-way flexible member is generally indicated at 25, and comprises two legs 26 and 27. It also comprises a gearing 28, viz. a row of gear teeth, positioned where it meshes with bottom gear wheel 24. The other end of member 25 is not seen in the drawing, but is similar to the end of two-way flexible elements 30 that will now be described and has a gearing, viz. a row of gear teeth, which meshes with the gear wheel carried by the preceding sprayer shaft, or, if the sprayer shown is the first, it engages an element of a control station, as will be hereinafter described with reference to Fig. 3.

Two-way flexible member 30 comprises legs 31 and 32 and gearing 33. Gearing 33 meshes with the upper gear wheel 23 of shaft 21 of the illustrated sprayer. When said shaft is rotated, gear wheel 23 causes one of

the legs 31-32 to be drawn in and the other leg to be paid out. Two-way flexible member 30 meshes with a gear wheel on the shaft of the next sprayer, which is not seen in the drawing. Therefore, if sprayer shaft 21 is rotated by a certain angle, the shaft of the next sprayer will be rotated by the same angle, and the said rotation will be transferred from one sprayer shaft to the following one, all along the row of sprayers. If a sprayer is missing, but a shaft similar to a sprayer shaft is present, the rotation will be transmitted in the same way.

At the control station means are provided for supporting the first two-way flexible member and for displacing said member to draw one leg in and pay the other leg out. The simplest way to provide this, is to set at the control station a shaft carrying a gear wheel and to provide means for manually or mechanically rotating said shaft by the desired angle, whereby to rotate all the sprayers about their vertical axis. No flexible member need be provided after the last sprayer. The control station may be programmed to activate the sprayers to spray towards a desired direction for predetermined periods, during which the cattle eat. Similarly, the control station may be programmed to activate the sprayers to spray towards a different desired direction and range for predetermined periods, during which the cattle normally lie. In this case, the control station may be programmed to activate the sprayers to spray while oscillating within a predetermined sector.

Fig. 3 illustrates shows an embodiment of the connection of the first sprayer, generally indicated at 40, with a control station generally indicated at 41. Fig. 7 illustrates at an enlarged scale a detail of said connection. However, Fig. 3 could equally illustrate the connection between two successive lines of sprayers, set at an angle from one another and functionally coordinated. The control station illustrated comprises an arm

42 supported on structural element 10 in any convenient way. In the example illustrated, arm 42 is supported by a rigid connection 43, which in turn is attached to sleeve 47, similar to sleeve 38 of Fig. 2, which is attached to structural element 10. A two-way flexible member 45 carries two gearings, viz. rows of gear teeth, 46 and 51. Arm 42 supports a motor 48. Housing 49 houses a gear transmission from the shaft of said motor 48 to a shaft 53 to which is keyed a gearwheel 54. Gear wheel 54 meshes with a gear 55 keyed to a shaft 56, to which is keyed a gear wheel 50. Gear wheel 50 meshes with gearing 51, and therefore, when it rotates, flexible member 45 is displaced along itself, viz. one of its legs is drawn in and the other is paid out. Gearing 46 displaces sprayer 40 (only partially seen) in the way previously described in connection to Figs. 1 and 2. Other means, in general any convenient means, could be used to displace flexible member 45 by drawing in one leg thereof and paying the other leg out. For instance, a shaft corresponding to shaft 50 could be rotated manually, through a lever or in any other way. It would be even possible to substitute a plain or grooved wheel for gear wheel 50, to omit gearing 51, and to relay on frictional engagement between said plain or grooved wheel and flexible member 45. Housing 49 also conveniently contains the control processor which controls the operation of the apparatus according to the relevant parameters, comprising the parameters of the wind.

Fig. 4 schematically shows the operation of a row of sprayers 60 in a shed wherein the cows 61 are arranged in two opposite, straight rows 62 and 63. In the situation of Fig. 4 no wind is blowing, or the wind is so weak to have no influence on the water sprays. Therefore, each sprayer 60 produces a spray 64 which reaches one of the cows 61, though it may exceptionally also reach second cow, as shown at 65. Figs. 4 and 5A are plan views; however, for the sake of illustration, the cows are shown as they would be seen in vertical and not in plan view. Whenever spraying is terminated,

the control processor tilts all sprayers to be in a position that is essentially parallel to the cables 45, so as to save space required for tractors to clean the cattle's excrement.

Fig. 5A shows a similar situations for a shed in which the cows 71 are arranged in two opposite rows each of which comprises two pairs of segments 72-73 and 74-75 respectively, the segments of each pair forming an angle α between them. Sprayers 70 are arranged correspondingly in two rows, and each row comprises two segments which form the same angle α between them. At the point where the two segments of each row meet, is placed a sprayer 76 which transmits the angle of displacement from the preceding sprayer 70' to the following sprayer 70". In place of sprayer 16, if said sprayer is not requested to spray a cow, a shaft should be placed to transmit said angle of displacement.

Fig. 5B shows a similar situations for a shed in which the cows 71 are arranged within the area of a closed polygon. Sprayers 70 are arranged correspondingly in two rectangles, and each row comprises four segments which form the same angle α between them. At the point where the two segments of each row meet, is placed a sprayer 76 which transmits the angle of displacement from the preceding sprayer 70' to the following sprayer 70". In place of sprayer 16, if said sprayer is not requested to spray a cow, a shaft should be placed to transmit said angle of displacement. This way, the angles of all the sprayers are concurrently changed using a single motor. The control station may cause all sprayers to oscillate within a predetermined sector, as well as to terminate the operation of those sprayers that are in an opposite position with respect to the wind direction.

Fig. 6 illustrates the case that the sprayers must be arranged in two segments of row placed at different levels, due to the structure of the shed.

The sprayers are assumed to be structured as illustrated in Figs. 1 and 2. As in said figures, the last sprayer 80 of the first segment has a shaft 21, actuated by flexible member 25 through its upper gear wheel 23. Its lower gear wheel 24, however, meshes with a gear wheel 82 keyed to a first slanted shaft 83, to which a second gear wheel 84 is also keyed. Gear wheel 84 meshes with gearing 86 of a slanted flexible member 85. When shaft 21 is angularly cdisplaced, gear wheel 84 displaces flexible member 85 by drawing in one leg thereof and paying the other leg out. Another gearing 87 is carried by flexible member 85 and meshed with gear wheel 88 of a second slanted shaft 89 and rotates said shaft. Shaft 89 has another gear wheel 90 keyed thereto. Gear wheel 90 meshes with a gearing 91 carried by another flexible member 92, which transmits angular displacements to a following sprayer, not seen in the drawing, in the same way that has been described hereinbefore.

Fig. 8 schematically illustrates a wind sensor 95, which comprises a plate or flag 96 mounted on an arm 97 attached to a rotatable shaft 98. Sensor 95 preferably comprises means, such as e.g. spring means or a linear electrical potentiometer, for reacting to the rotation of shaft 98, so that it be contained within predetermined limits no matter what may be the direction and speed of wind that are considered possible. The rotation of shaft 98 generates a signal, which is transmitted to the control of the apparatus. In a potentiometer implementation, the resistance scale may be divided to resistance ranges, each of which consisting of resistance values that correspond to turns of a selected gear wheel. The turns of said gearwheel are translated by the control station to a corresponding angle of each spraying device, so as to adjust its position and to determine whether its spraying or fan operation should be maintained or terminated. It is possible to concurrently control In extreme wind conditions, e.g. if the wind strongly blows against the desired direction of the water sprays, the

said signal may cause the sprayers to stop operation in order to avoid waste of water.

Figs. 9 and 10 schematically illustrate one example of the influence of the wind on the angular adjustment of the sprayers. Only one row of sprayers 100 and one row of cows, schematically indicated at 101, are shown. In Fig. 9, no significant wind is blowing. Each of the water sprays 102 is essentially symmetric with respect to an axis 103, which is the axis of the fan of the sprayer and is therefore perpendicular to the outer surface 104 of the sprayer. In Fig. 10, a significant wind 110 is blowing crosswise of the sprayer row, from the left as seen in the drawings, viz. from the west. To take the wind into account, each sprayer has been turned by an angle β counterclockwise, as seen in the drawing, viz. with the axis of its fan pointing approximately in a northwest direction. As a consequence, the water sprays have assumed the curved shape 111 and reach the cows in spite of the wind.

While the invention has been described and illustrated as intended for the cooling of cattle, it should be understood that the apparatus of the invention may be used for other purposes, viz. for cooling targets other than cattle, for instance vegetation, other animals, greenhouses, poultry, industrial facilities, , such as textile, queues in entertainment points, and this used too is comprised within the scope of the invention.

While embodiments have been described and illustrated to exemplify the invention, it will be understood that the invention may be carried out with many modifications variations and adaptations without departing from the scope of the claims.

CLAIMS

1. Method for cooling cattle, particularly cows, distributed in an orderly configuration, particularly in corrals and more particularly in a shed, which comprises the following steps:

a) providing a plurality of sprayers;

b) distributing said sprayers in a configuration corresponding to said configuration of the cattle;

c) concurrently actuating said sprayers to generate water sprays, each of them directed substantially to at least one cow body;

d) sensing the direction and optionally the speed and/or other relevant parameters, if any, of the wind; and

e) concurrently changing the direction of the water sprays according to the direction and optionally the speed and/or other relevant parameters, if any, of the wind, in such a way that each spray will still be directed substantially to at least one cow body.

2. Method according to claim 1, wherein the cattle are cows.

3. Method according to claim 1, further comprising transmitting the direction and speed of the wind and/or other relevant parameters, if any, of the wind to a computer which outputs the calculated change of the direction of the water sprays about a vertical axis.

4. Apparatus for cooling cattle, particularly cows, distributed in an orderly configuration, particularly in rows and more particularly in a shed, which comprises:

I – a plurality of sprayers, arranged in a configuration corresponding to said orderly configuration of the cattle;

II – actuating means for concurrently actuating and concurrently stopping all of said sprayers;

III – wind sensor means for sensing the direction and optionally the speed and/or other relevant parameters, if any, of the wind;

IV – kinematic connecting means for concurrently controlling the direction of the water sprays generated by said water spray generators; and

V – means for actuating said kinematic means according to the direction and optionally the speed and/or other relevant parameters, if any, of the wind sensed by said sensing means.

5. Apparatus according to claim 4, wherein the kinematic means connect each sprayer to the next, and concurrently changes or adjusts, if and when needed, the direction of the water sprays generated by them.

6. Apparatus according to claim 5, wherein the kinematic means changes or adjusts the direction of the water sprays by angularly displacing the sprayers about a substantially vertical axis.

7. Apparatus according to claim 4, wherein each sprayer preferably comprises a fan having blades defining a blade diameter, and a guard grille, and comprises a nozzle unit for feeding water from a feed conduit, which is being centrally mounted on the downstream side of the grille and the blades.

8. Apparatus according to claim 4, wherein each sprayer is pivotally displaceable about a vertical axis.

9. Apparatus according to claim 4, further comprising a computer which inputs the direction and speed of the wind and/or other relevant

parameters, if any, sensed by the wind sensor, and outputs the calculated rotation of the sprayers about a vertical axis required to maintain the desired direction and range of the water sprays.

10. Apparatus according to claim 4, wherein the other relevant wind parameters include the humidity of the wind and its temperature.

11. Apparatus according to claim 4, wherein each sprayer is mounted on a support solid with a vertical shaft, said shaft being rotatably mounted in a sleeve attached to a static element.

12. Apparatus according to claim 4, wherein the vertical shaft carries a first gear wheel and a second gear wheel.

13. Apparatus according to claim 4, further comprising a control station for controlling the direction of the sprayers.

14. Apparatus according to claim 4, wherein the kinematic connecting means for concurrently controlling the direction of the sprayers comprises, for each sprayer, a two-way flexible member which comprises two legs connected at both their ends and passing around the vertical shaft of each sprayer.

15. Apparatus according to claim 14, comprising a control station for controlling the direction of the sprayers, and wherein the first flexible member, that passes around the vertical shaft of the first sprayer, also passes around a support located at the control station.

16. Apparatus according to claim 14, wherein each flexible member, other than the first, passes around the vertical shafts of two adjacent sprayers.

17. Apparatus according to claim 14, further comprising means for displacing the first flexible member along itself from the control station, and transmission means for translating the displacements of said flexible member about a vertical axis.

18. Apparatus according to claim 14, further comprising transmission means for transmitting rotation from a preceding sprayer to the next.

19. Apparatus according to claim 18, wherein the transmission means comprises a first gear wheel rotatable with the preceding sprayer, a gearing carried by the flexible member that engages both sprayers, which gearing meshes with said first gear wheel, and a second gear wheel rotatable with the next sprayer, said gearing also meshing with said second gear wheel.

20. Apparatus according to claim 4, further comprising means for rotating each sprayer about a horizontal axis.

21. Apparatus according to claim 4, further comprising means causing and controlling the intermittent cooling of cows.

22. Apparatus according to claim 4, wherein the sprayers are aligned successively along at least two segments forming an angle to one another and a sprayer or a vertical shaft having two gear wheels keyed thereto is located at the junction of said two segments.

23. Apparatus according to claim 4, wherein the sprayers are aligned successively along at least two segments at different levels from one another, which apparatus further comprises a slanted flexible member

transmitting angular displacement from the last sprayer of one segment to the first sprayer of the following segment, a first slanted shaft rotatably connected to said last sprayer, a second slanted shaft rotatably connected to said first sprayer, said slanted flexible member connecting said first and said second slanted shaft.

24. Apparatus according to claim 23, wherein the last sprayer of one segment to the first sprayer of the following segment are provided each with a vertical shaft having an additional gear wheel keyed thereto, the first slanted shaft is rotatably connected to said last sprayer by a gear wheel keyed to said first slanted shaft and meshing with the additional gear wheel keyed to the vertical shaft of said last sprayer, and the second slanted shaft is rotatably connected to said first sprayer by a gear wheel keyed to the second slanted shaft and meshing with the additional gear wheel keyed to the vertical shaft of said first sprayer.

25. Apparatus according to claim 13, wherein the control station comprises sensor means for sensing the direction and speed of the wind and processing means for calculating from the sensed direction and speed, and optionally from other wind parameters, the desired angular displacement of the sprayers about substantially vertical axes.

Abstract

A method and apparatus is described for moistening cattle, especially cows, in sheds, and taking into account the effect of the wind. Rows of sprayers are provided which project water sprays directed toward the cattle. The sprayers may be angularly shifted to take into account the deviating effect of the wind. Processing means calculate the angular shift that is needed for the existing wind direction and intensity. All the sprayers concurrently receive the angular shift. Preferably said shift is transmitted to the first sprayer from a control station and successively from each sprayer to the next. In this way, a plurality of sprayers can be controlled even if they are not arranged in straight lines or at the same level, depending on the structure of the cattle shed.

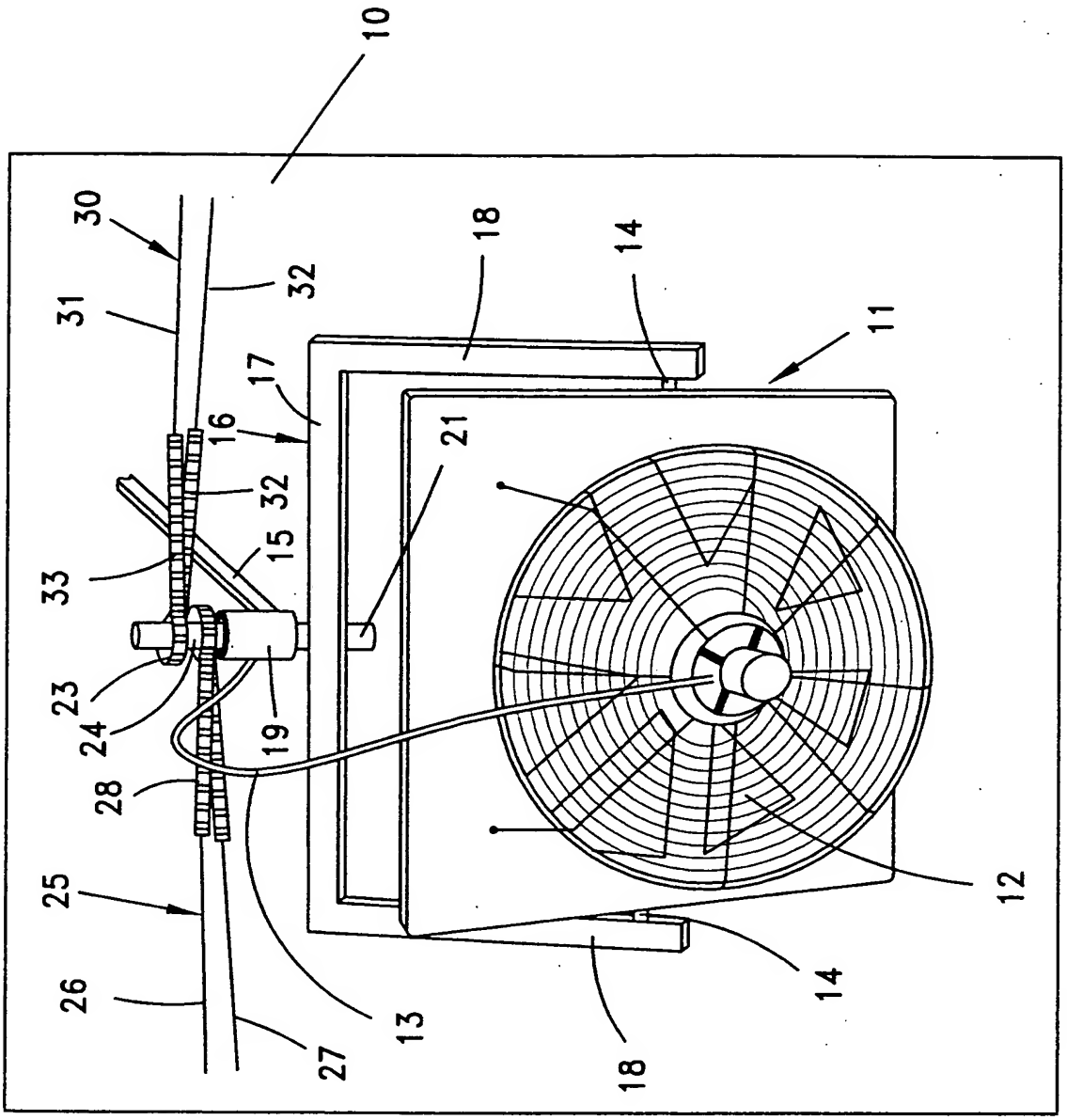


Fig. 1

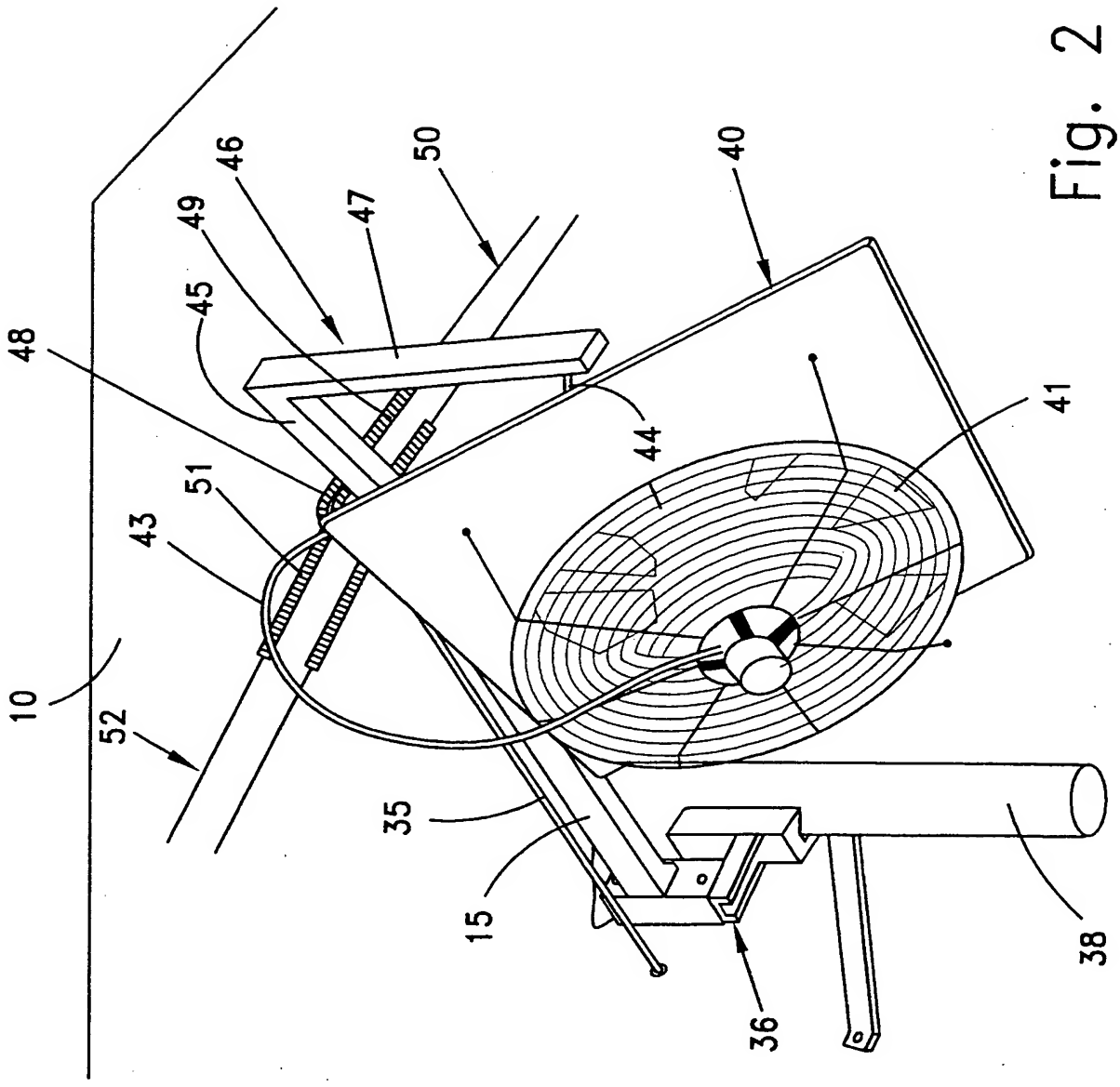


Fig. 2

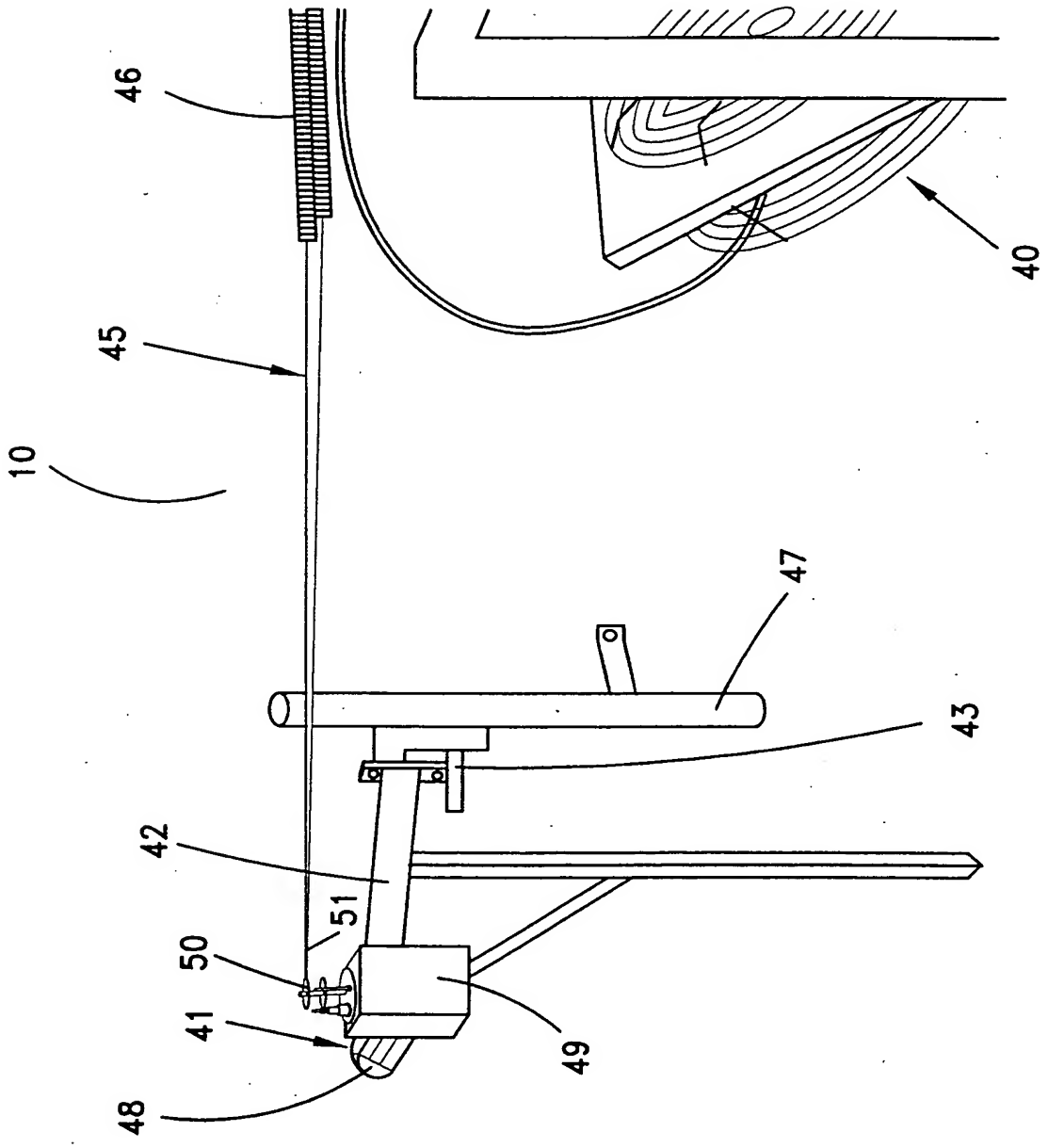


Fig. 3

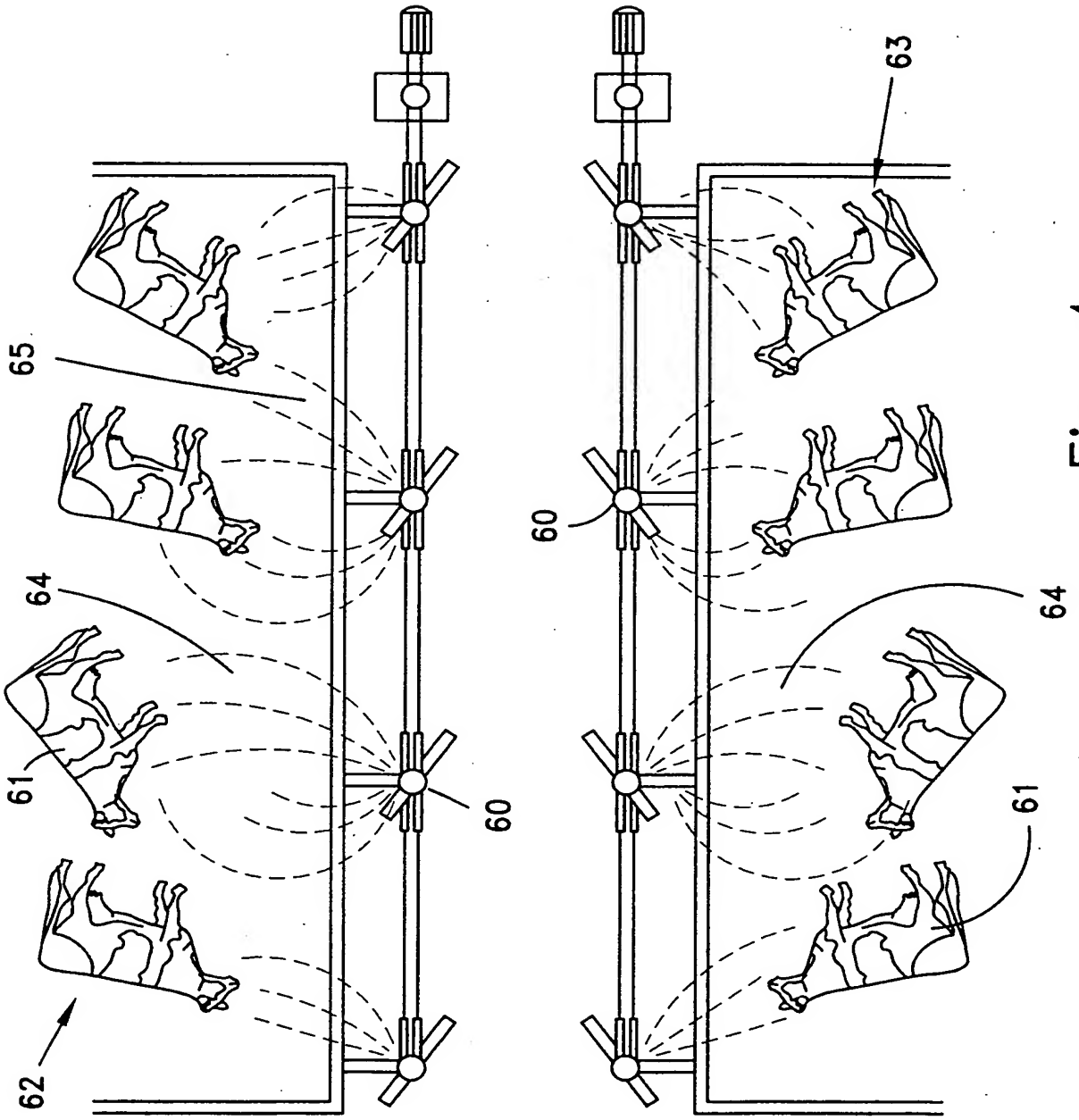


Fig. 4

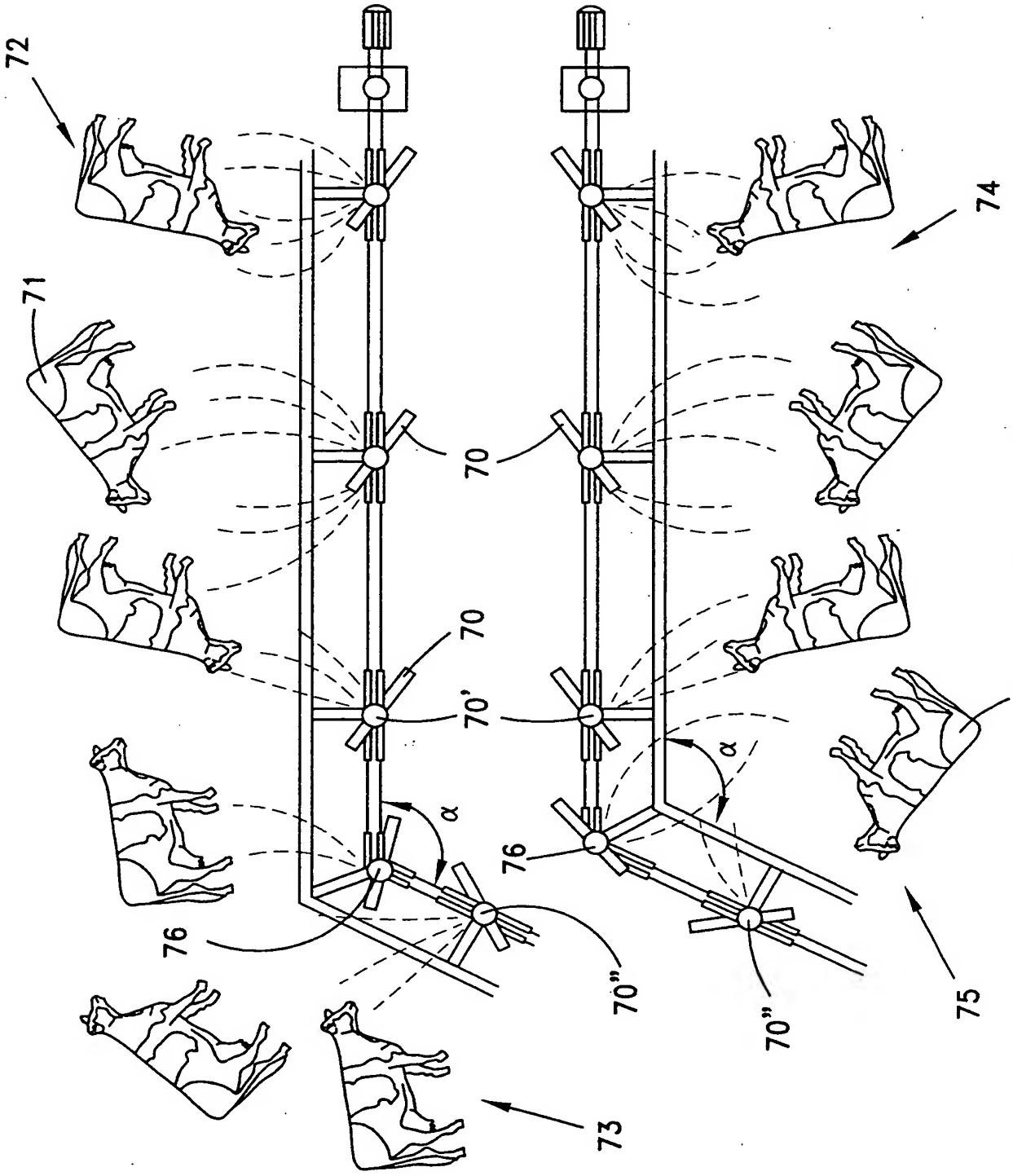


Fig. 5A

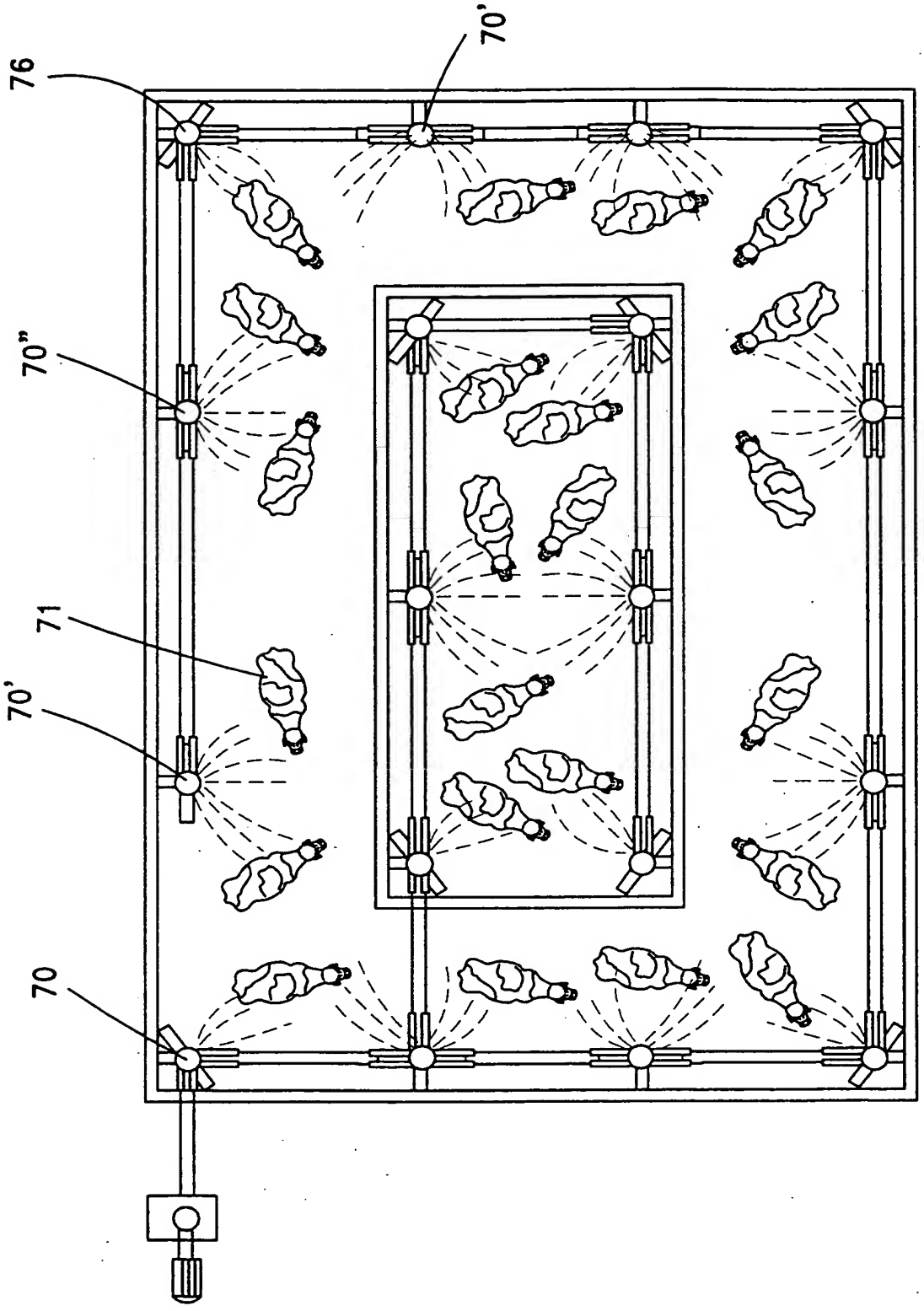


Fig. 5B

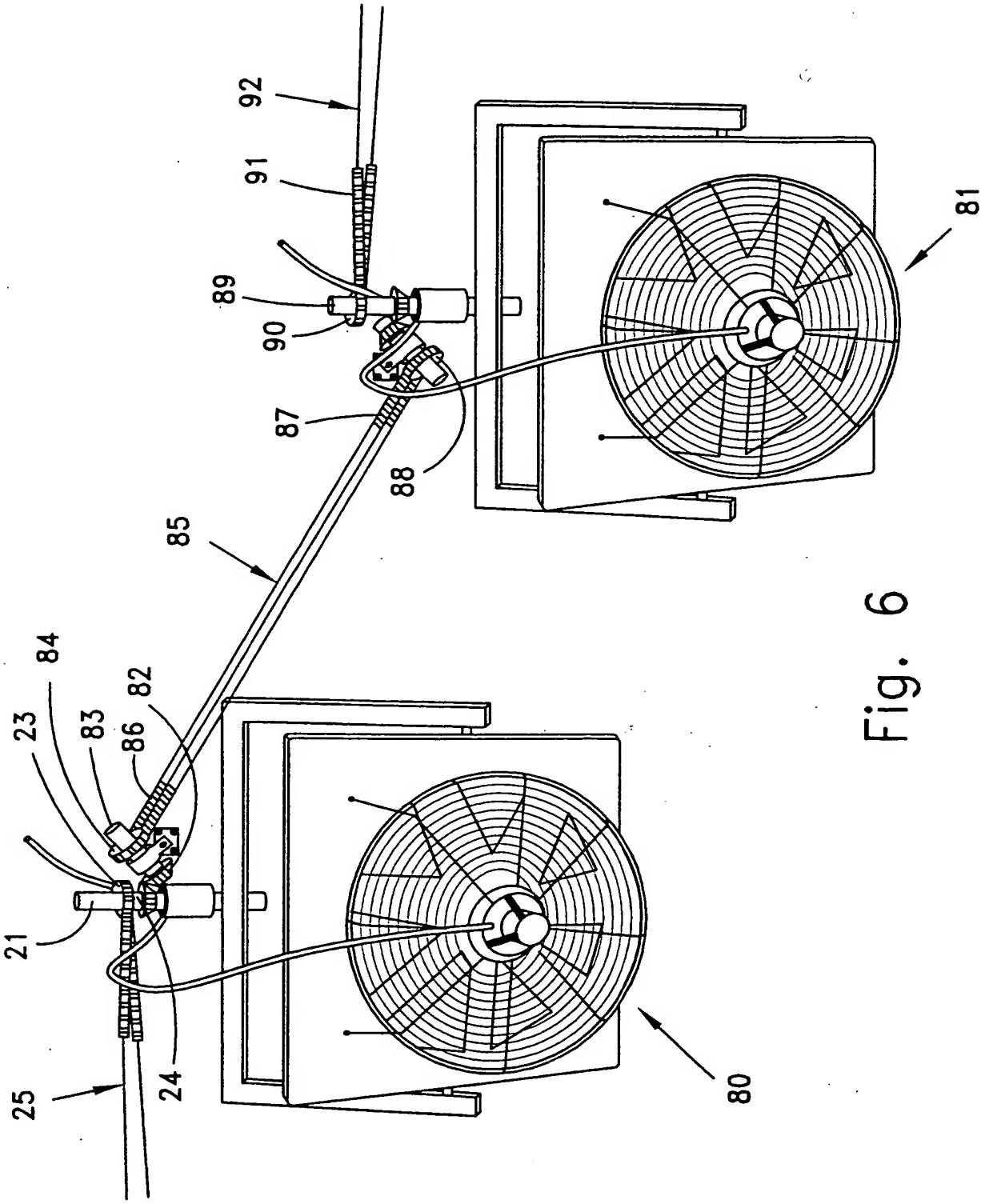


Fig. 6

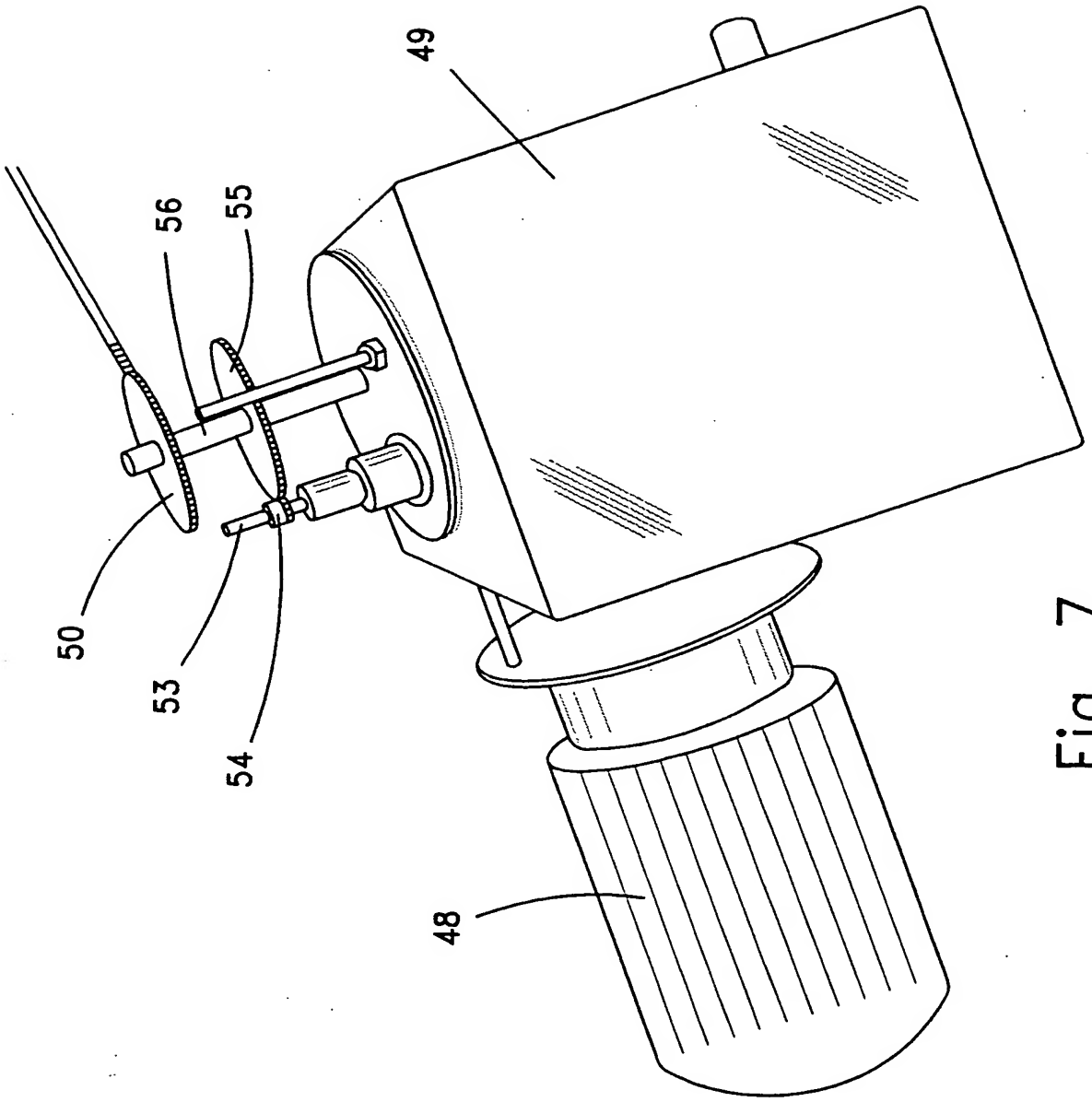


Fig. 7

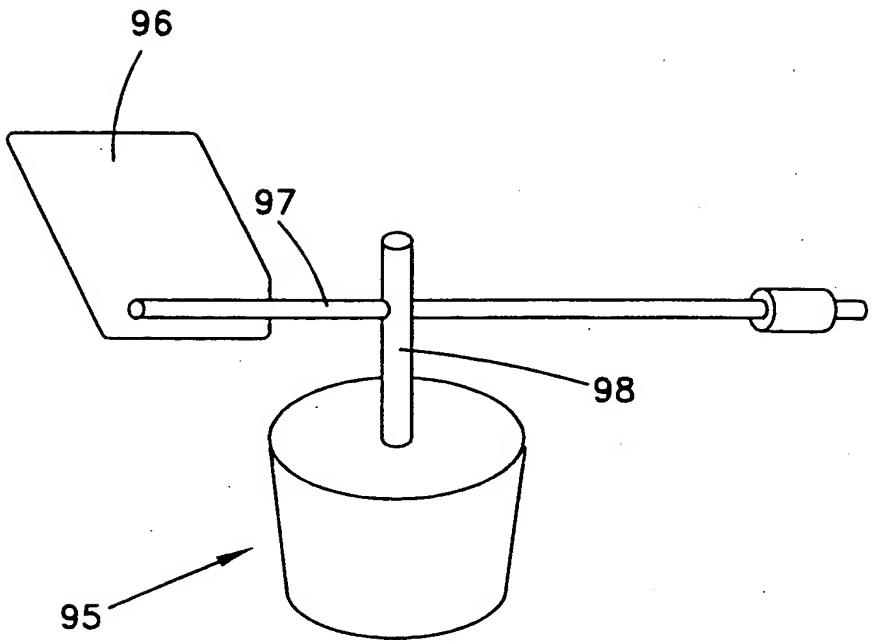


Fig. 8

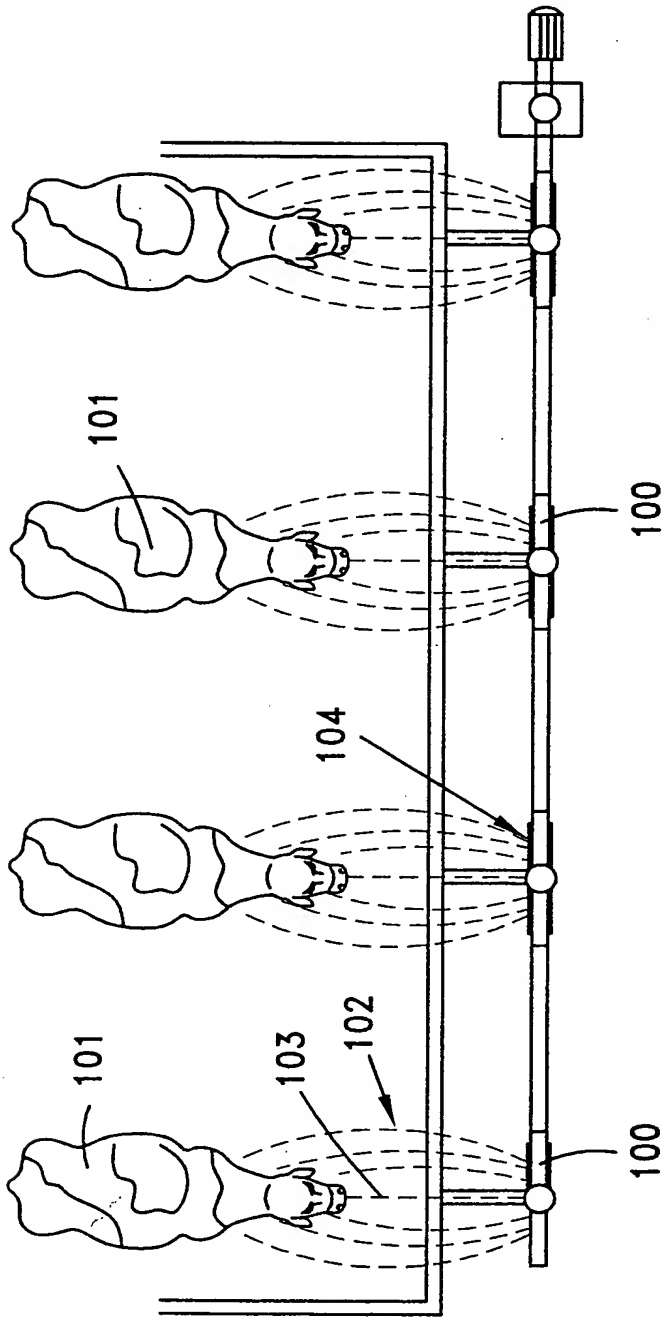


Fig. 9

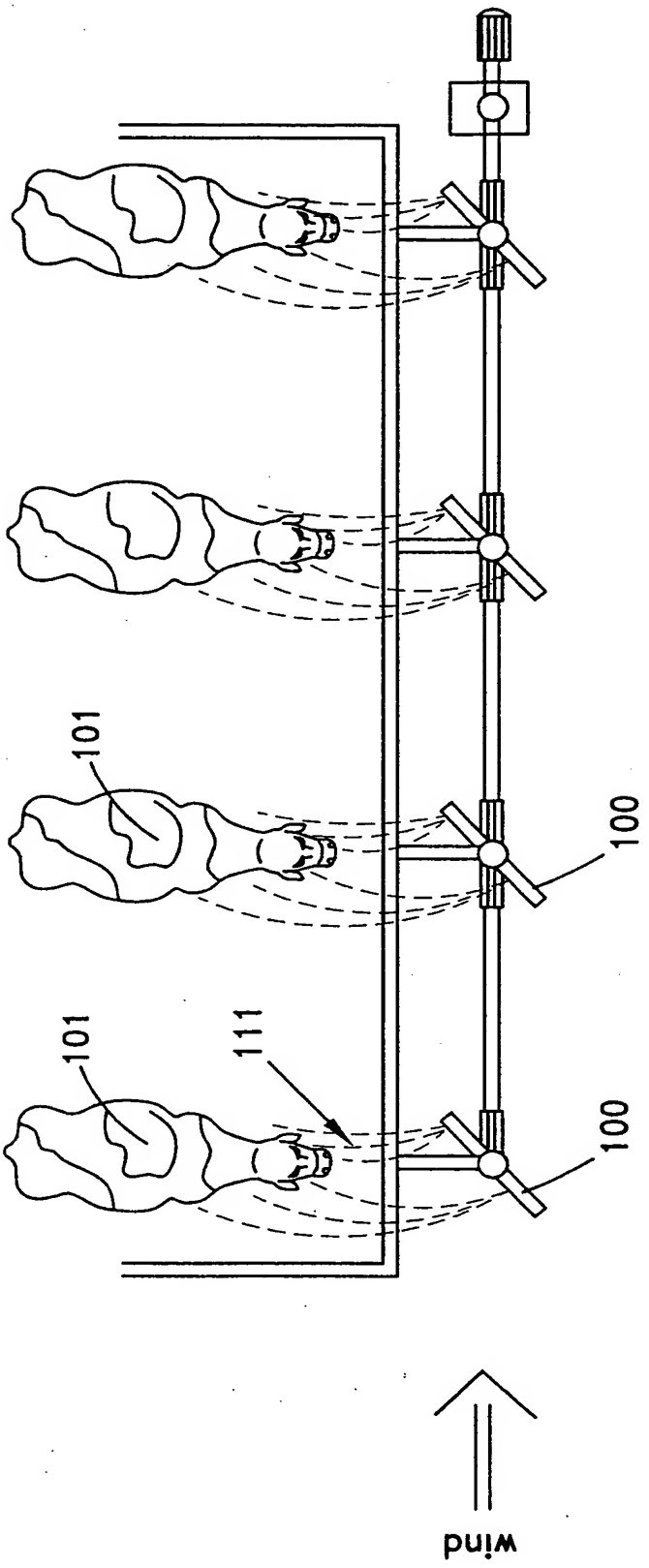


Fig. 10